Baltimore Harbor Assist Tug

MIDN David Hodapp
MIDN Seth Krueger
MIDN Phil Suchyta
MIDN Christopher Wozniak

Mission Requirements

- Operational Area
- Size Requirements
- Endurance
- Maintenance
- Accommodations
- Speed
- Hull

Mission Requirements Con’t

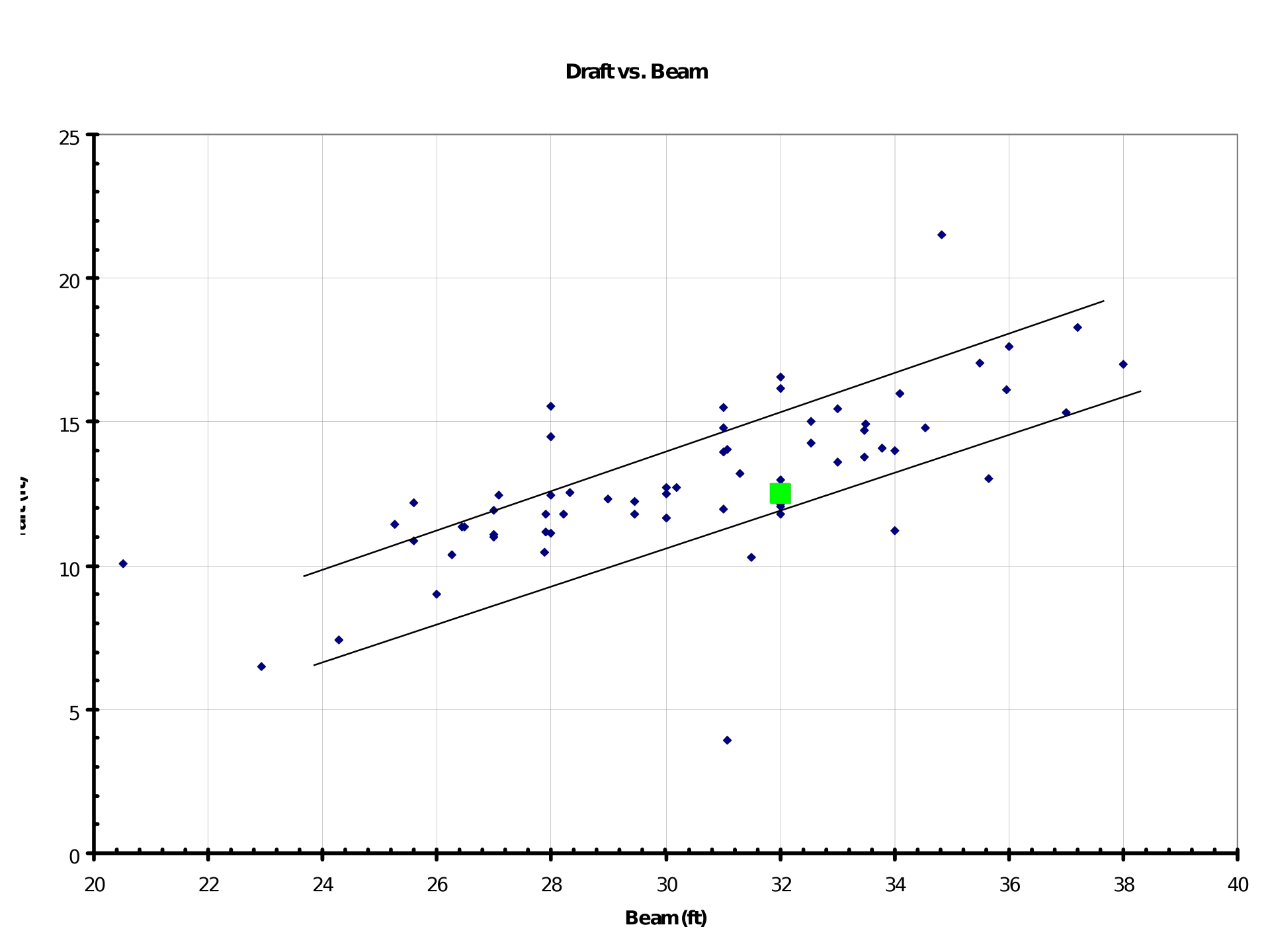
- Propulsion
- Firefighting
- Seakeeping
- Deck Space
- Tankage
- Ship Controls

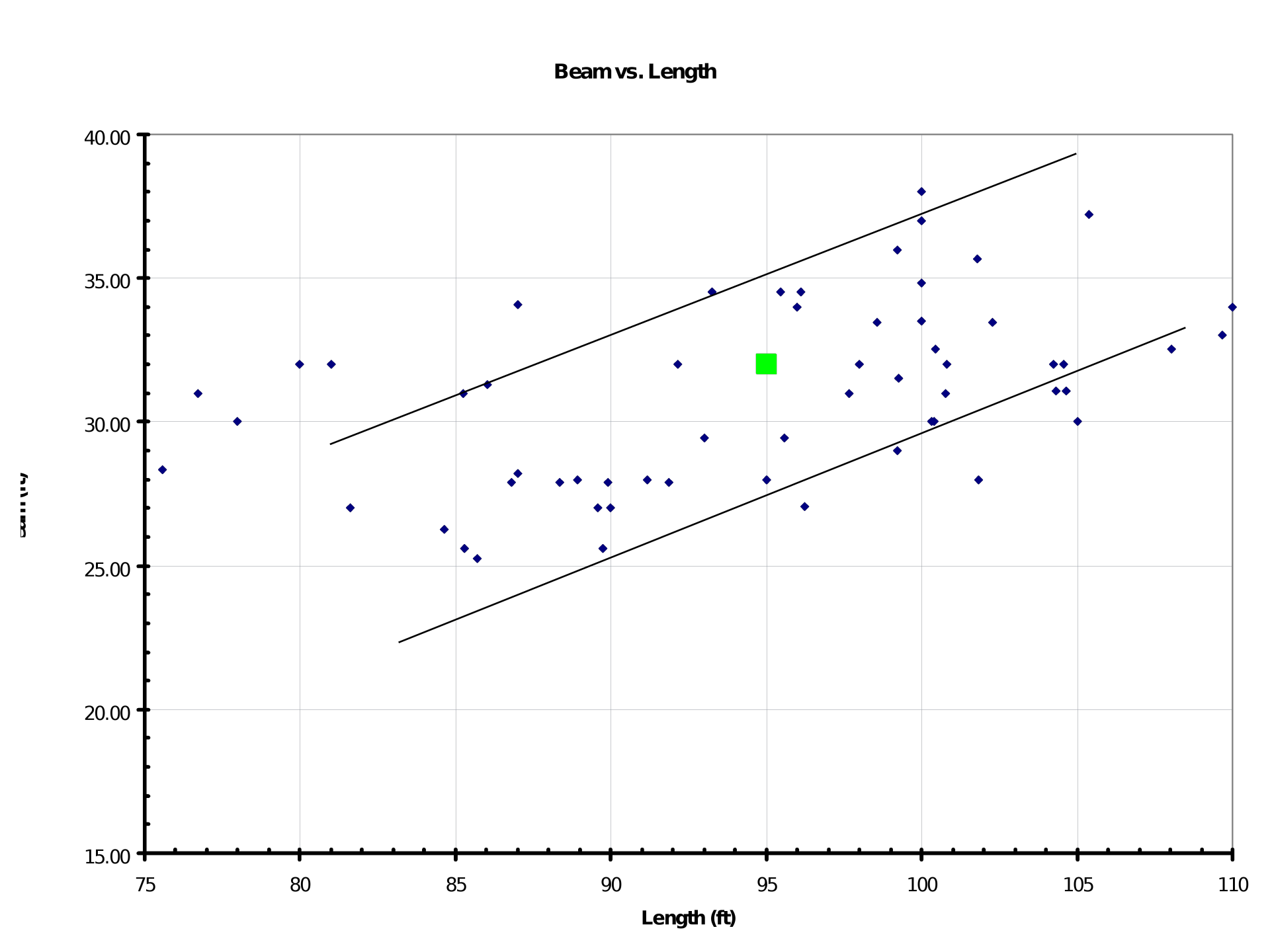

M
CAPE ROMAIN
ROMAIN

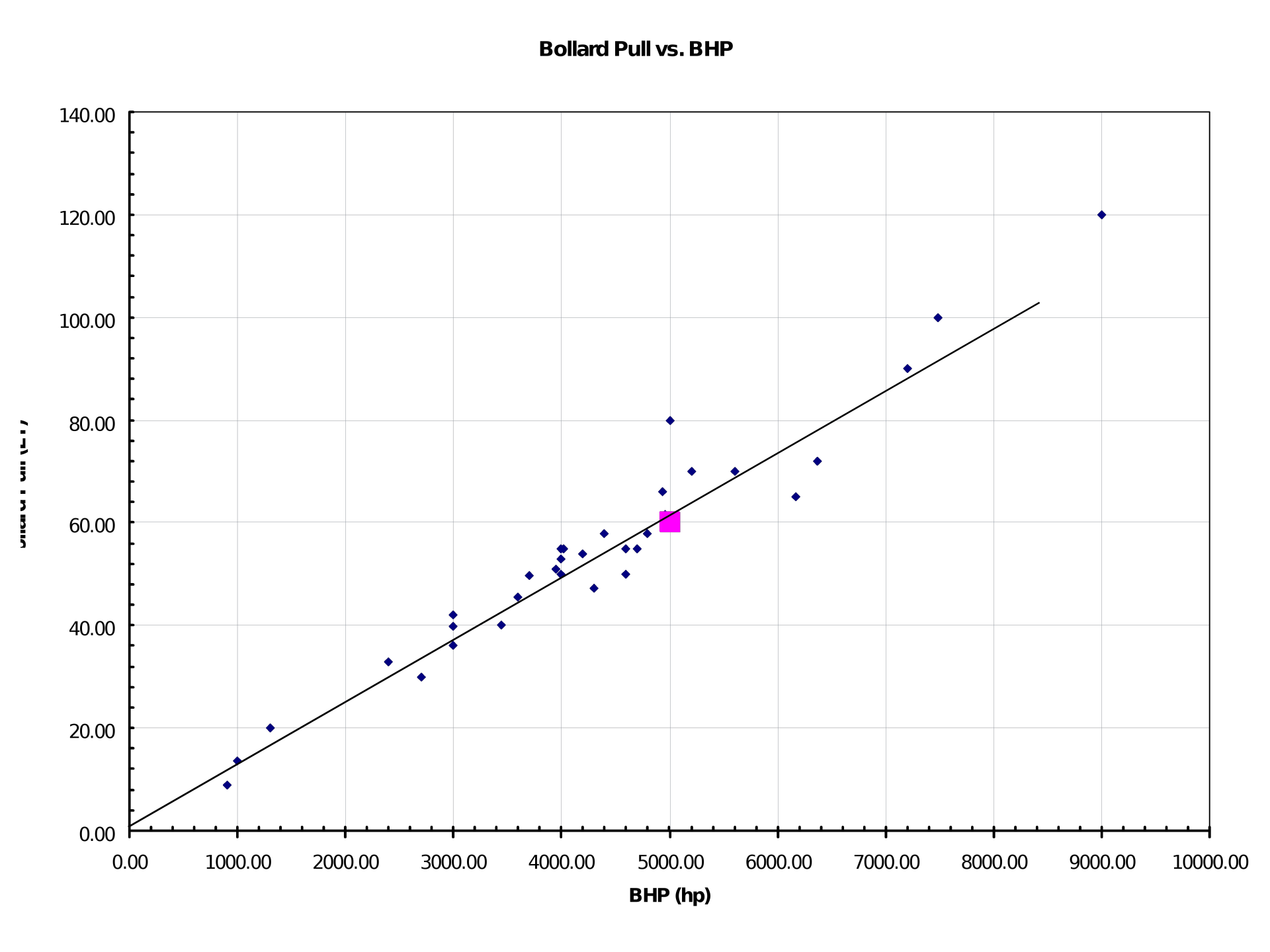

FURUNO

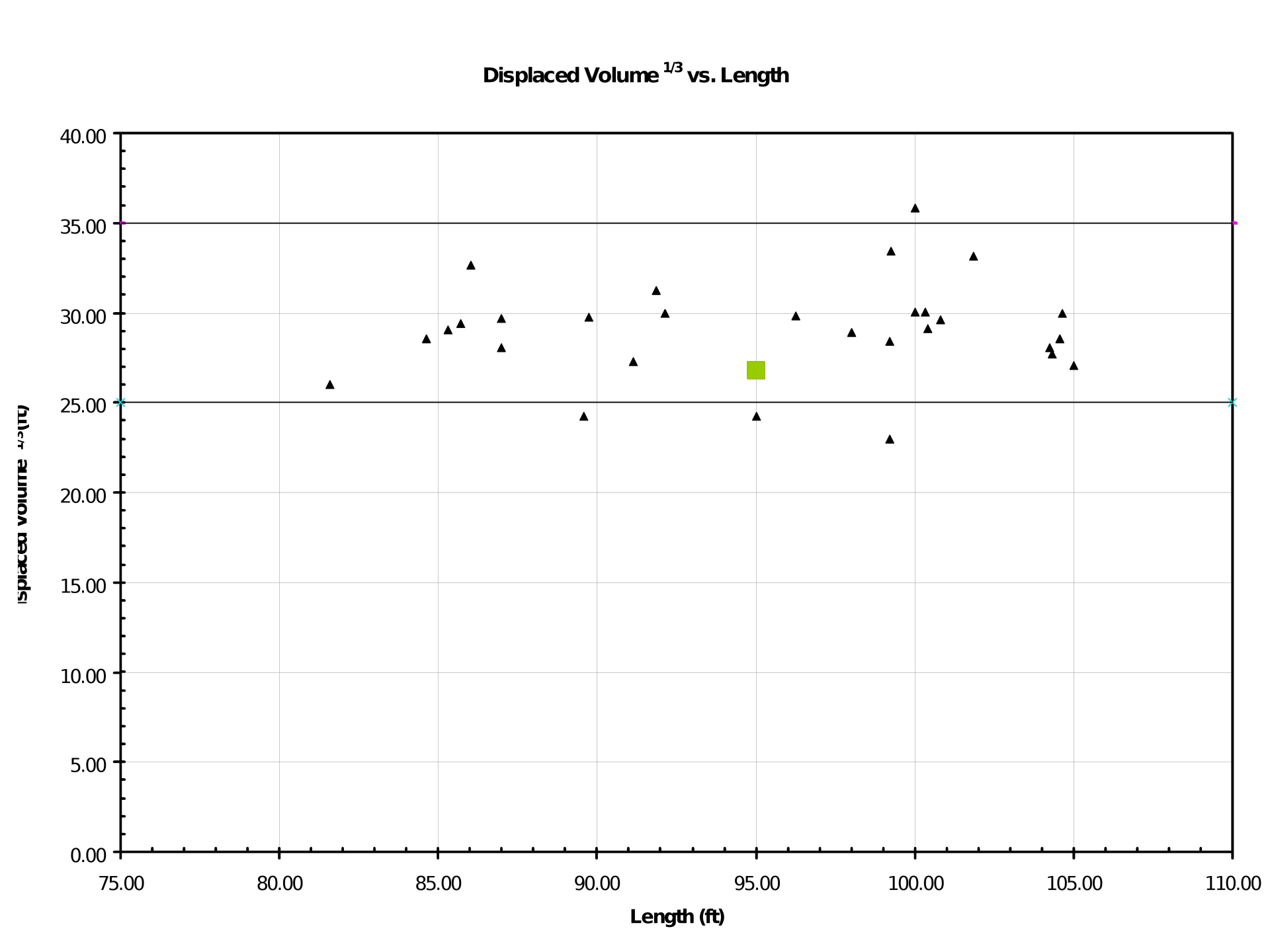

SEWELLSPOINT
WIL. DEL


M

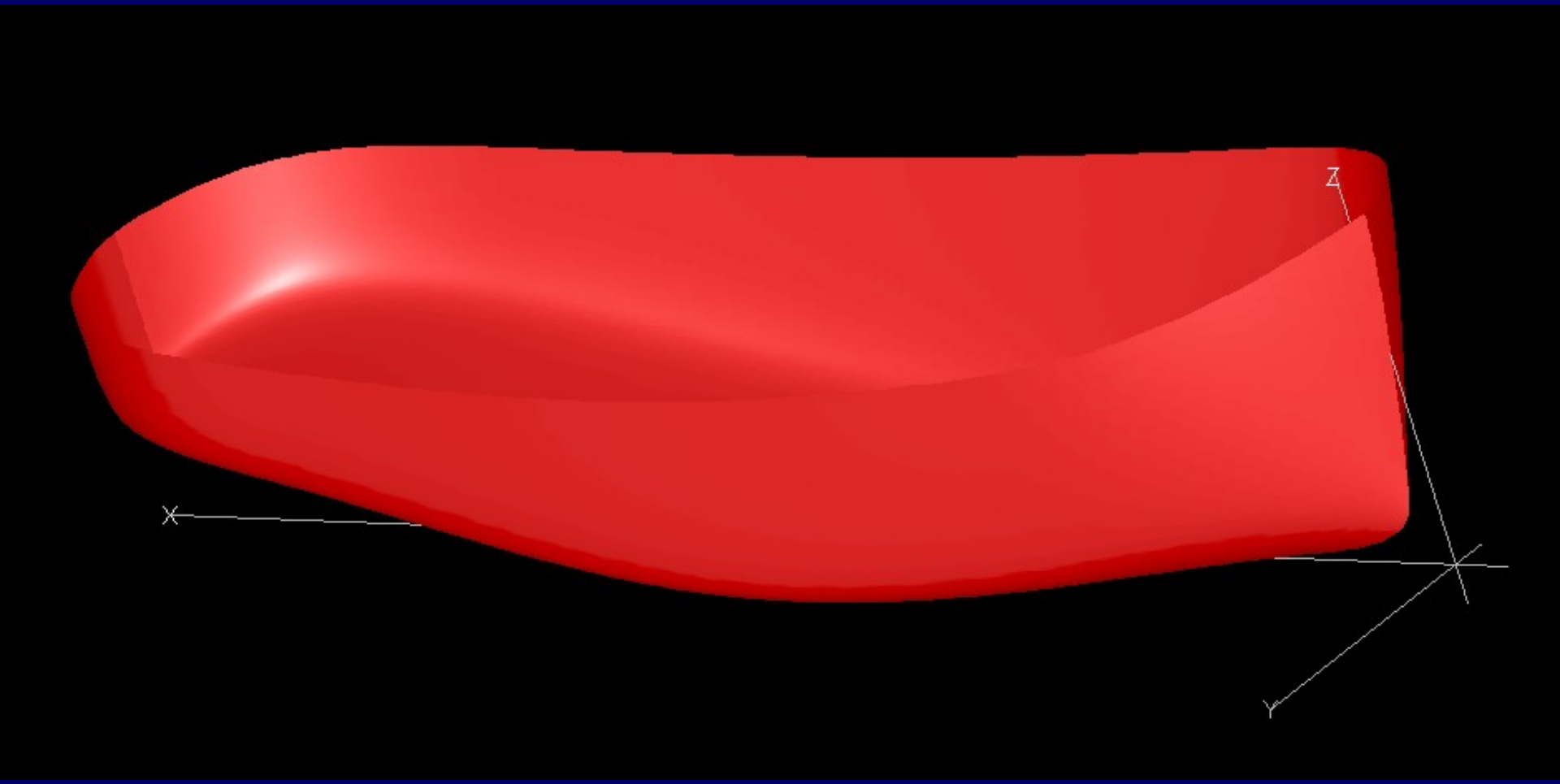

Draft vs. Beam
25
20
15
10
5
0
20
22
24
26
28
30
32
34
36
38
40
Beam (ft)


Beam vs. Length
40.00
35.00
30.00
25.00
20.00
15.00
75
80
85
90
95
100
105
110
Length (ft)


Bollard Pull vs. BHP
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
9000.00
10000.00
BHP (hp)

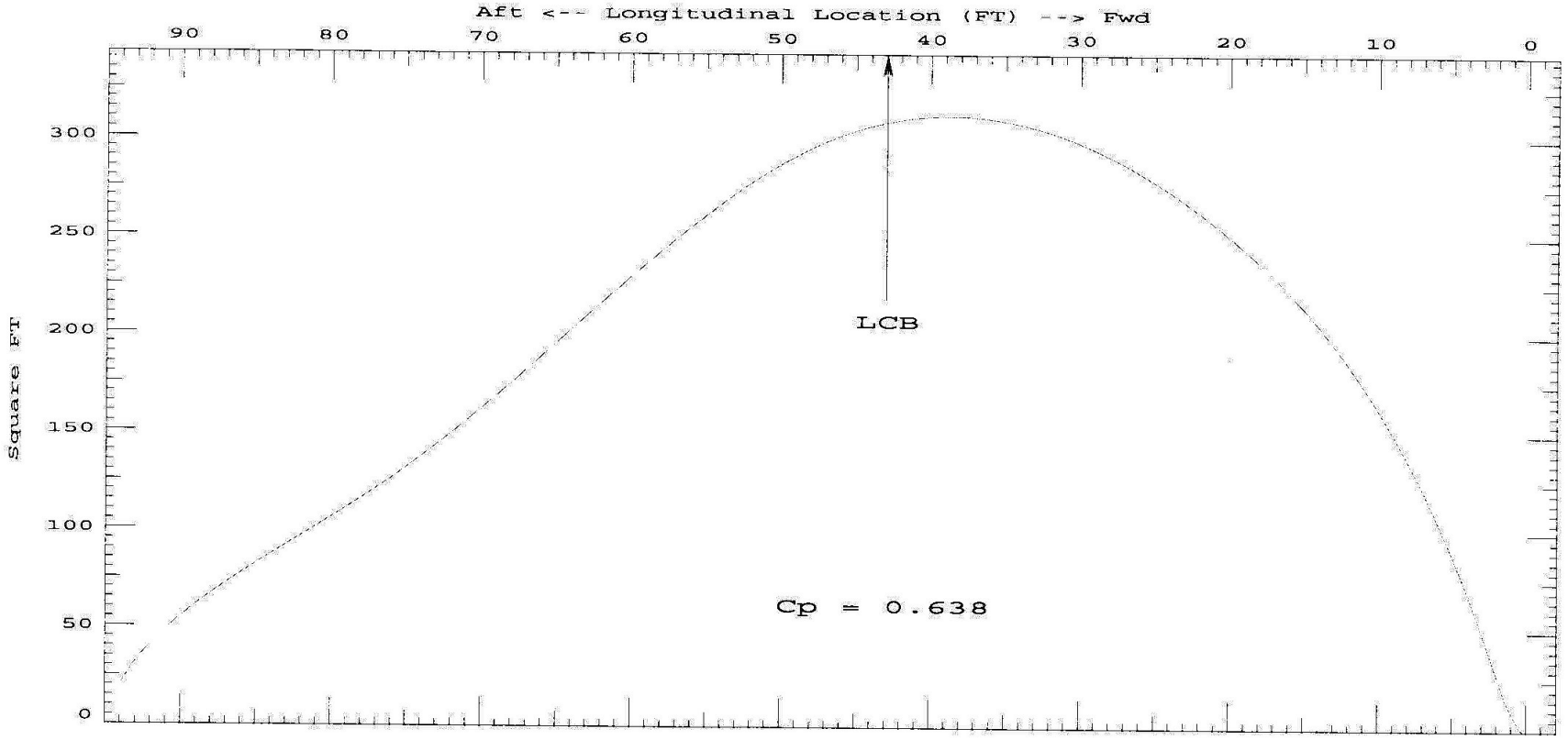

Displaced Volume 1/3 vs. Length
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
75.00
80.00
85.00
90.00
95.00
100.00
105.00
110.00
Length (ft)

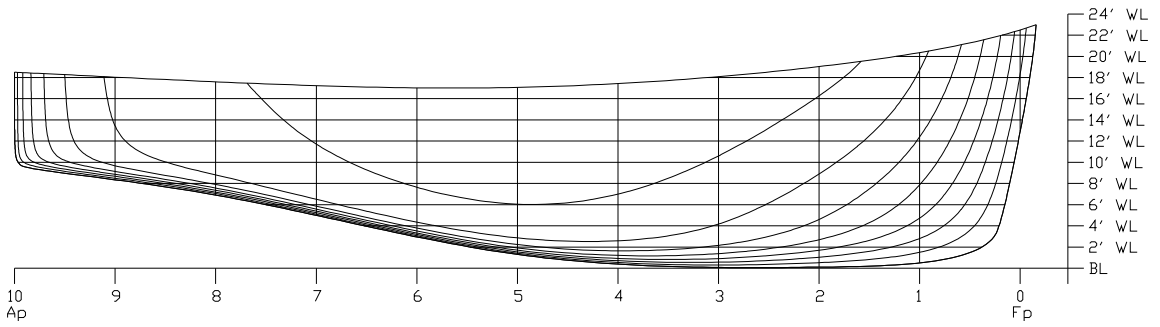
Hull Model Created in FastShip 6.1

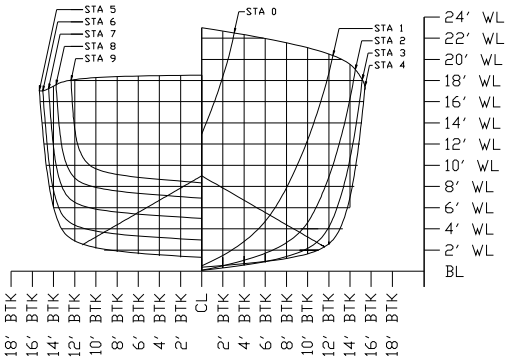


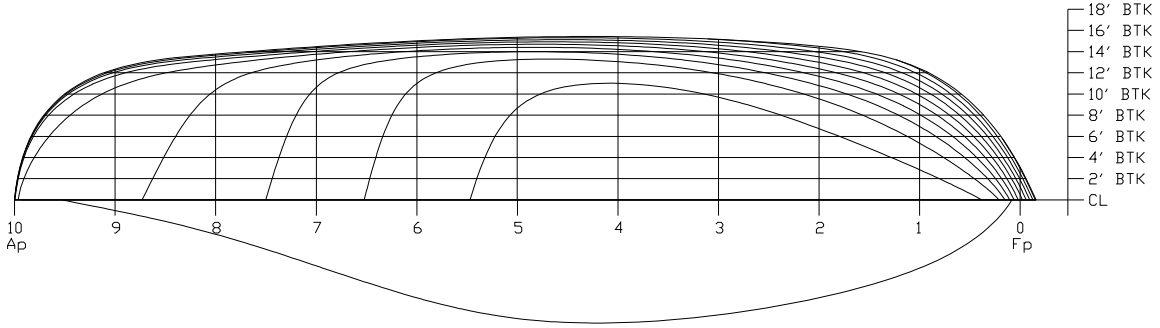
S E C T I O N A R E A S
LEVEL TRIM, NO HEEL

Part: HULL Component: HULL.



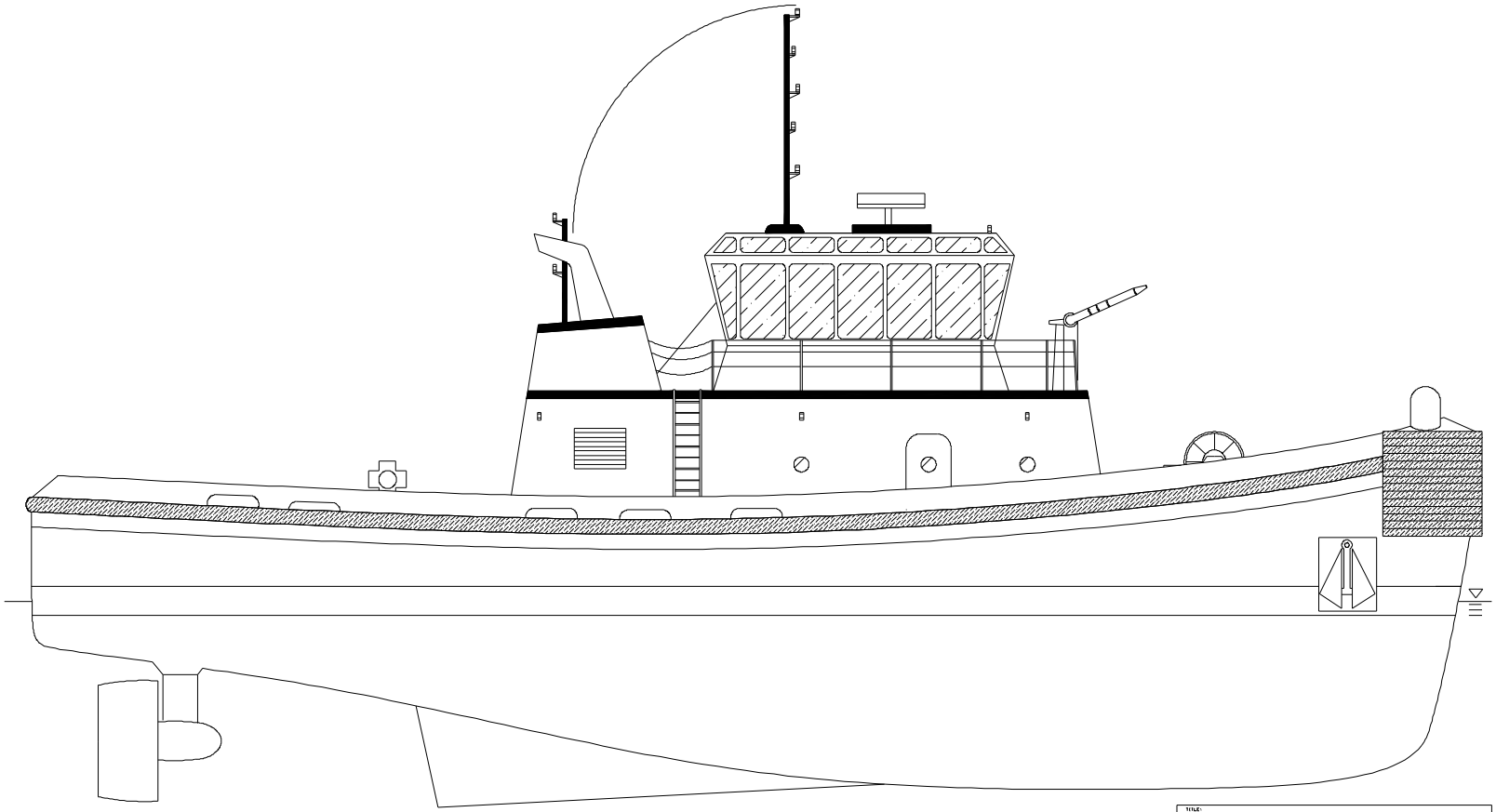




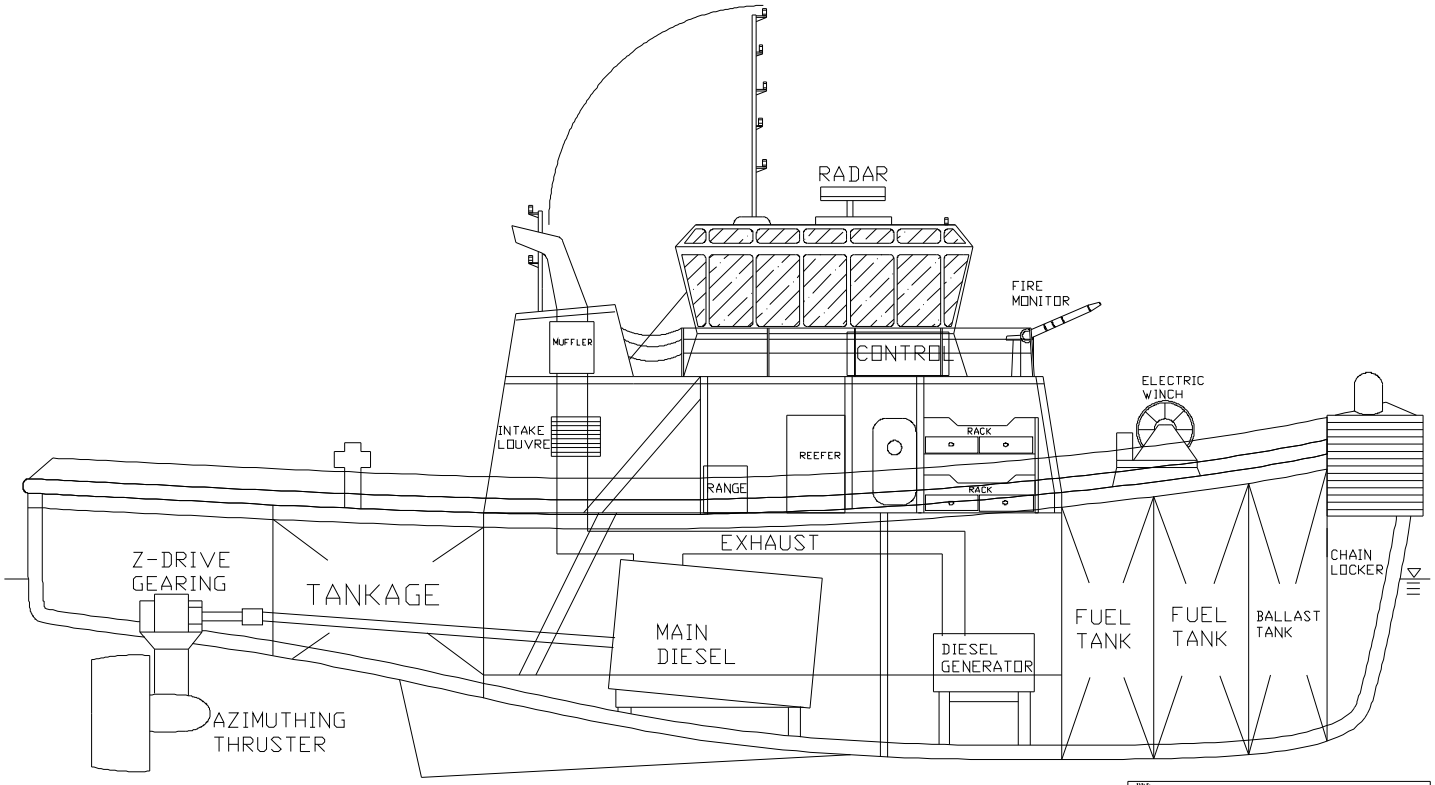


TITLE: HARBOR TUG LINES PLAN		
PROJECT: EN476 DESIGN PROJECT		
NOTES: LOA = 96.500' ; LWL = 94.893' ; B = 30.855'		
BWL = 29.960' ; D = 22.924' ; T = 12.447'		
STA SPACING = 9.5' ; WL SPACING 2'		
BUTTOCK SPACING 2'		
DRAWN BY: DAVID P. HODAPP		DATE: 10 MAR 05
SCALE: NTS	REVISION: 2	FILE NAME: harbor_tug_lines_2.dwg

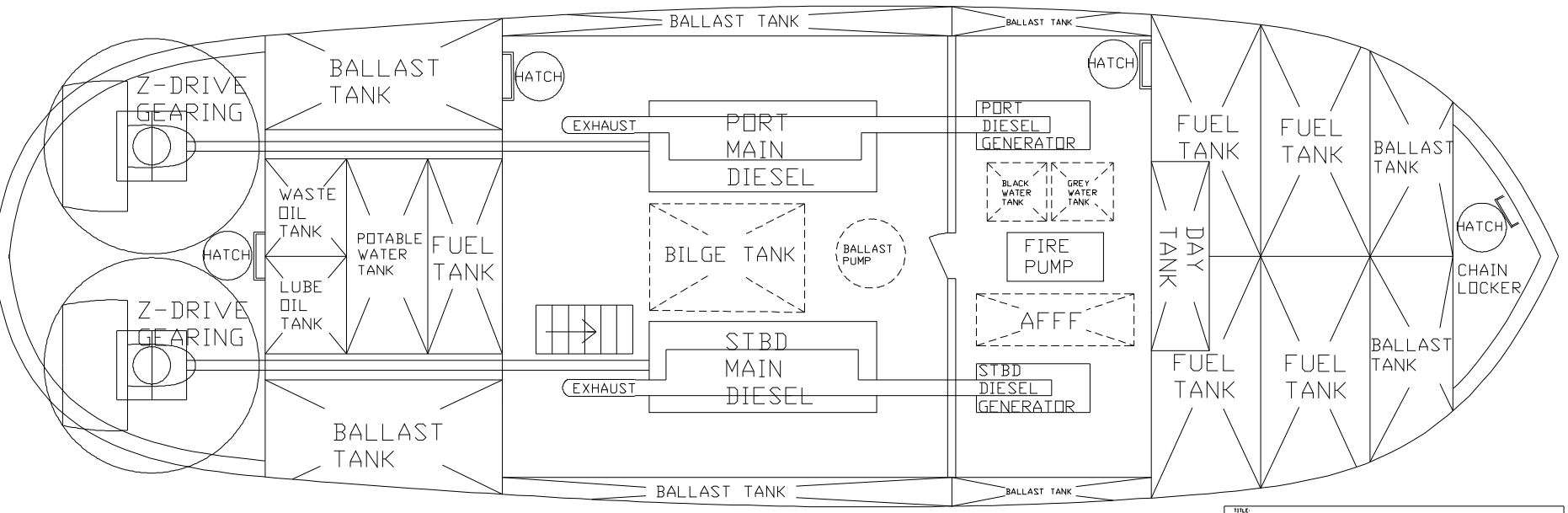
		Actual Values	Target Values	Reference
Weight	**LT**	537.94		
LCB	**ft**	43.03		
VCB	**ft**	7.88		
LCB / LWL		0.45		
LOA	**ft**	96.50		
LWL	**ft**	94.89	95.00	Parametric Analysis / Moran Towing Guidelines
BOA	**ft**	30.86	32.00	Parametric Analysis / Moran Towing Guidelines
BWL	**ft**	29.96		
Draft	**ft**	12.45	12.50	Parametric Analysis
Depth	**ft**	22.92		
Freeboard (Max)	**ft**	10.48		Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
Freeboard (Min)	**ft**		4.00	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
Shear Forward	**ft**		5.50	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
Shear Aft	**ft**		1.20	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
Wetted SA	**ft^2**	3555.38		
BM_T	**ft**	7.72		
C_B		0.53	0.55	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
C_M		0.83	0.87	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
C_{WP}		0.84	0.75	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
C_P		0.64	0.63	Jeffrey N. Wood, *Caldwell's Screw Tug Design*.
Deck				



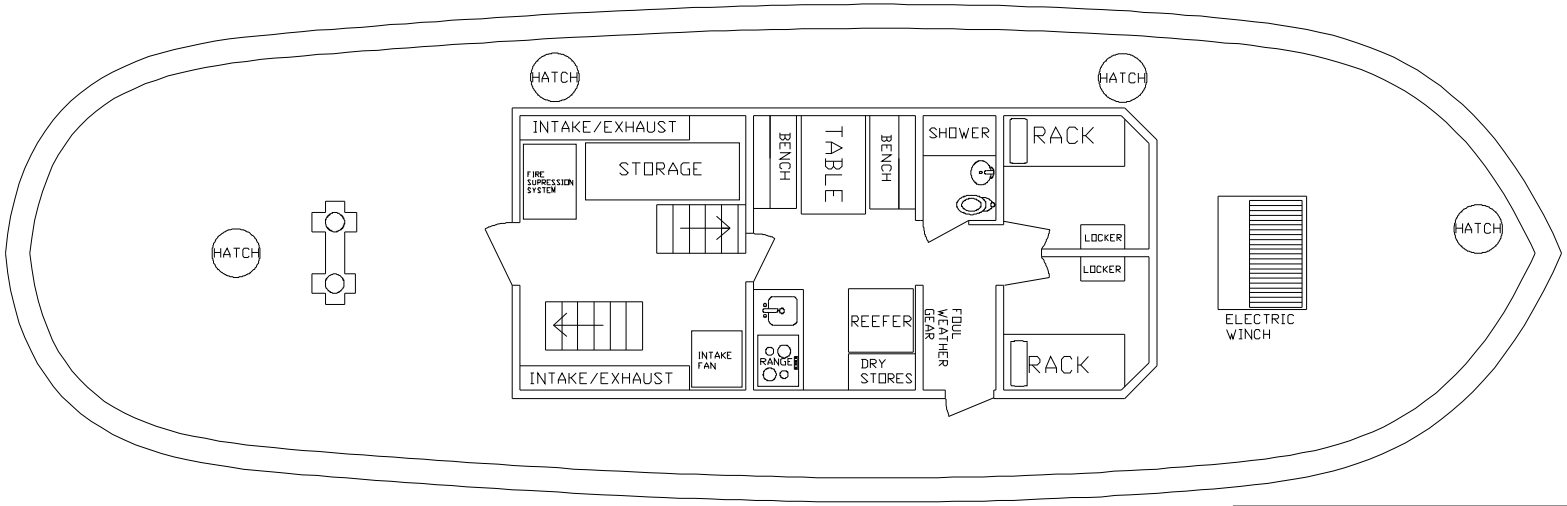
TITLE: HARBOR TUG OUTBOARD PROFILE		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
x		
x		
x		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg



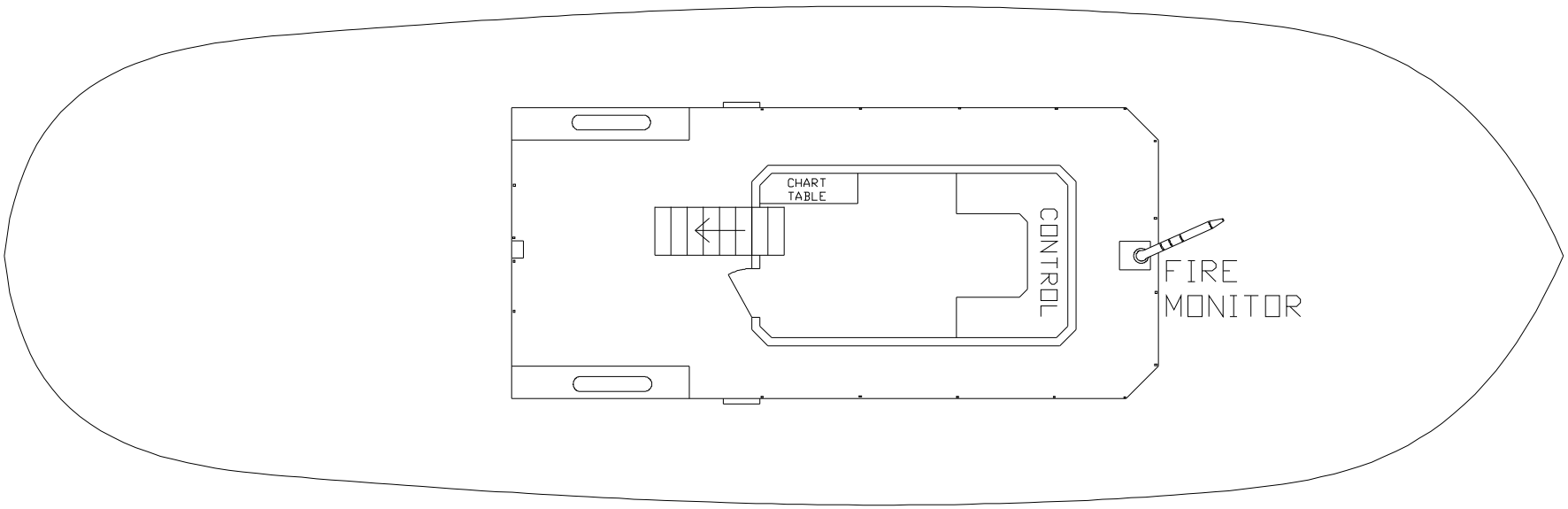
TITLE: HARBOR TUG INBOARD PROFILE		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
x		
x		
x		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg



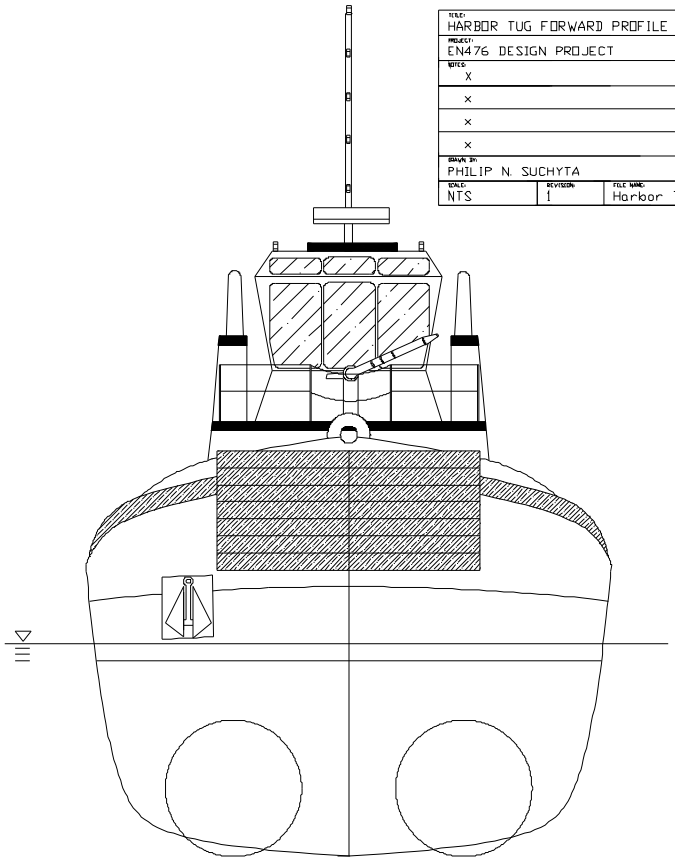
TITLE: HARBOR TUG 01 DECK LAYOUT		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
×		
×		
×		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg



TITLE: HARBOR TUG MAIN DECK LAYOUT		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
x		
x		
x		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg



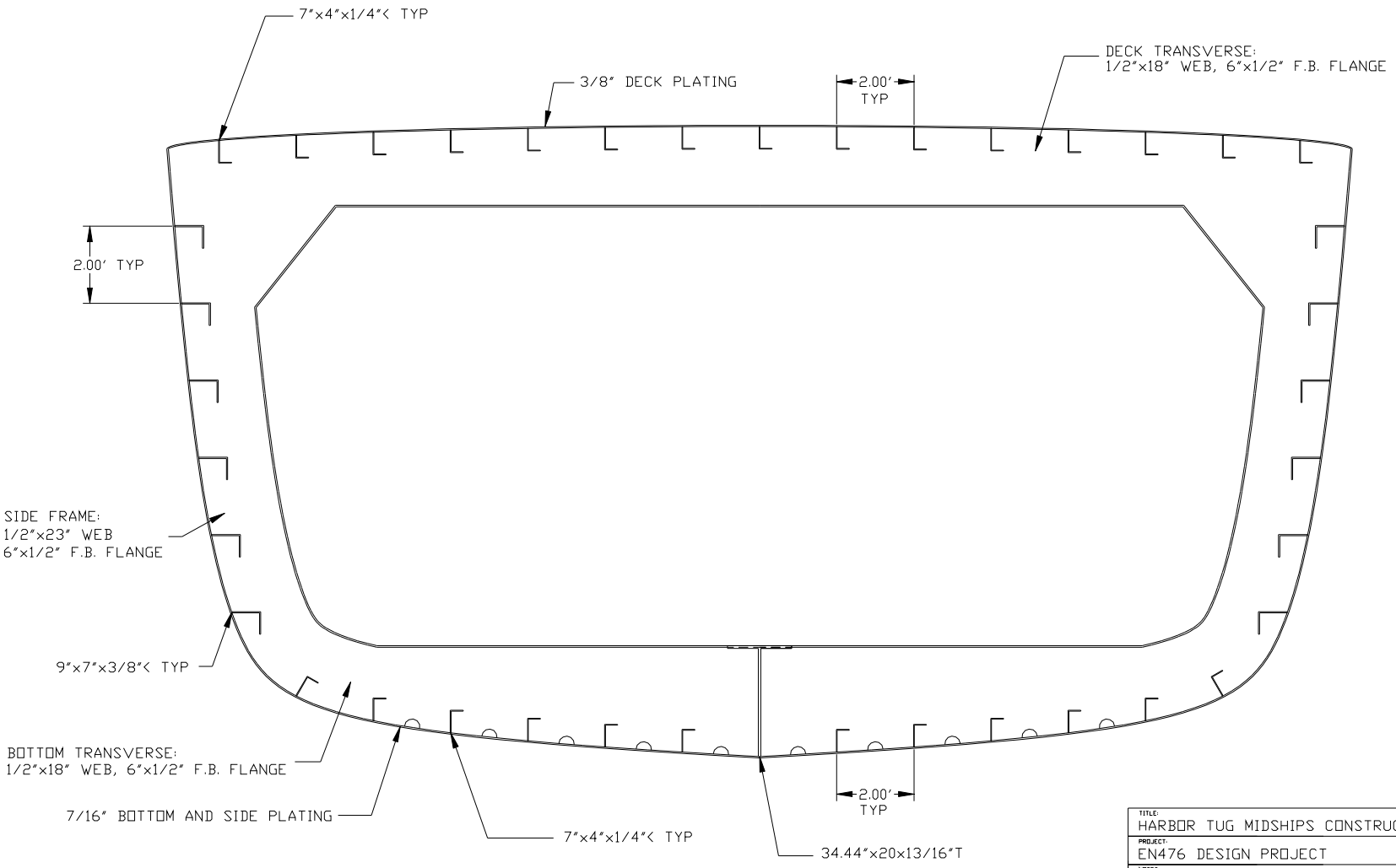
TITLE: HARBOR TUG 01 LEVEL LAYOUT		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
x		
x		
x		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg



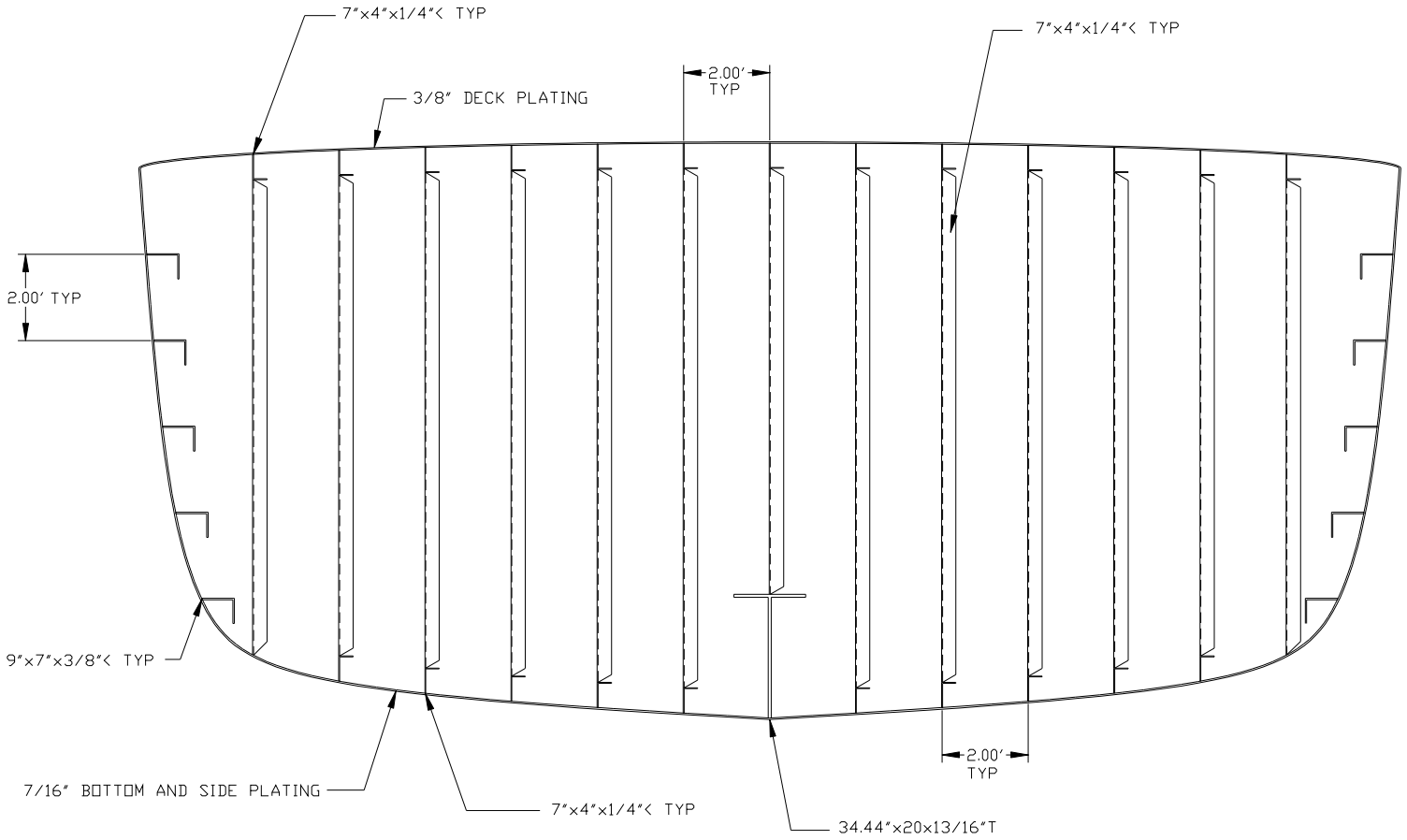
TITLE: HARBOR TUG FORWARD PROFILE		
PROJECT: EN476 DESIGN PROJECT		
NOTES: X		
×		
×		
×		
DRAWN BY: PHILIP N. SUCHYTA		DATE: 10 MAR 05
SCALE: NTS	REVISION: 1	FILE NAME: Harbor Tug 2000 3.dwg

Structural Members

		ABS RULE(S)	PASS / FAIL
Hull Girder SM	2806.5 ft-in^2	3/6.3.1	PASS
Hull Girder Moment of Inertia	25981.8 ft^2-in^2	3/6.3.3	PASS
Longitudinal Deck Beam	7"x4"x1/4"<	3/10.1.2, 3/2.7.2	PASS
Side Stringer	9"x7"x3/8"<	3/8.11.1, 3/2.7.2	PASS
Longitudinal Bottom Frame	7"x4"x1/4"<	5/7.5.5, 3/2.7.2	PASS
Center Keelson	34.44"x20x13/16 "T	3/7.3.2, 3/2.7.2	PASS
Deck Transverse	18"x6"x1/2"<	3/10.3.2, 3/2.7.2	PASS
Bracket		3/2.2	PASS
Side Web Frame	23"x6"x1/2"<	3/8.7.1, 3/8.7.3, 3/2.7.2	PASS
Bottom Transverse	18"x6"x1/2"<	3/7.5.2, 3/2.7.2	PASS
Bottom Plating	7/16"	3/15.3.2	PASS
Side Plating	7/16"	3/15.5.2	PASS
Deck Plating	3/8"	3/16.3	PASS
Watertight Bulkhead Stiffener	7"x4"x1/4"<	3/15.5.2, 3/2.7.2	PASS



TITLE: HARBOR TUG MIDSHIPS CONSTRUCTION PLAN		
PROJECT: EN476 DESIGN PROJECT		
NOTES: TRANSVERSELY FRAMED VESSEL		
8.00' TRANSVERSE FRAME SPACING		
ABS COMPLIANT (STEEL VESSELS < 295')		
TRIPPING BRACKETS PLACED AS REQUIRED		
DRAWN BY: DAVID P. HODAPP		DATE: 24 APR 05
SCALE: NTS	REVISION: 2	FILE NAME: midships_const.dwg



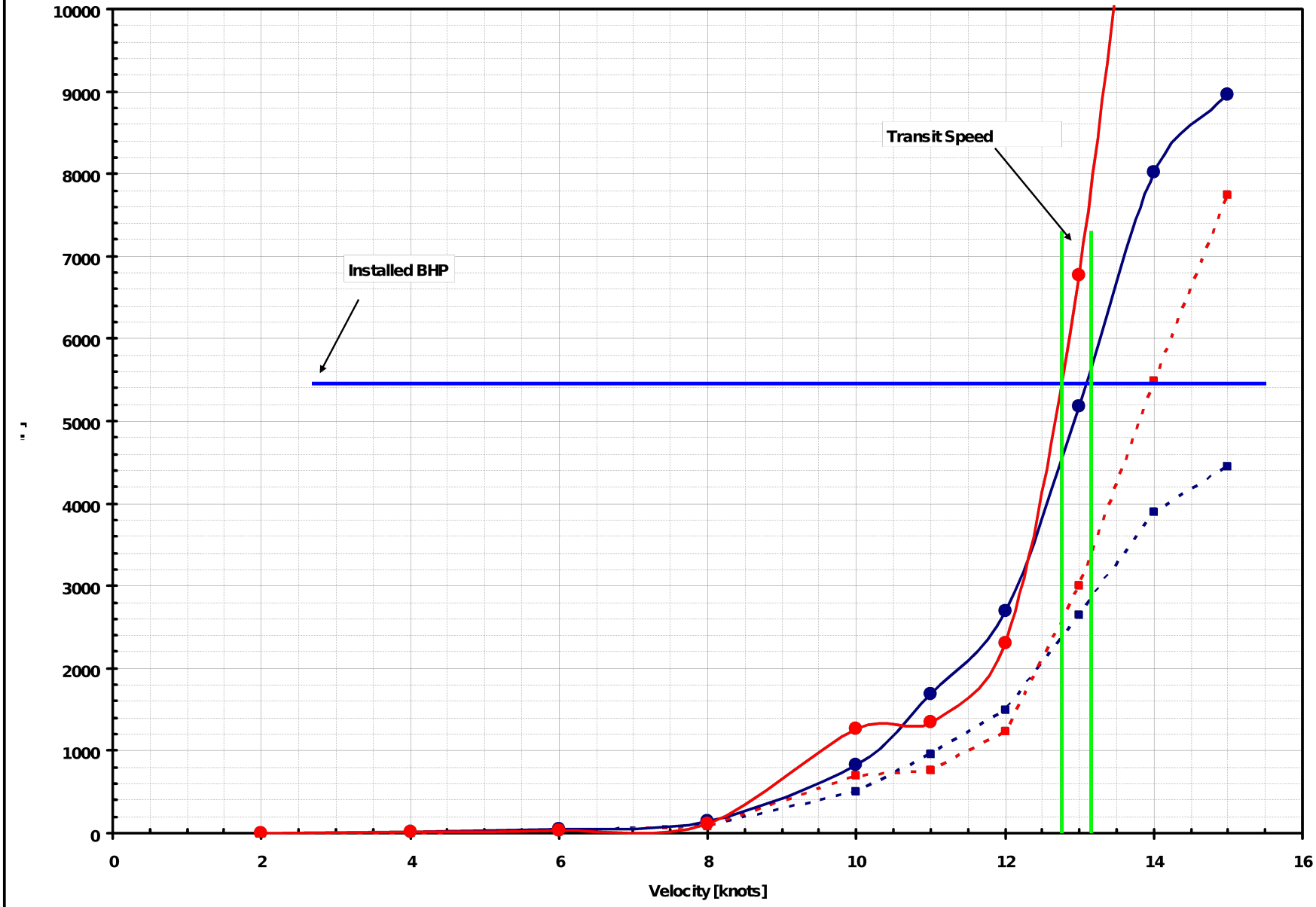
TITLE: HARBOR TUG TYPICAL WATERTIGHT BULKHEAD		
PROJECT: EN476 DESIGN PROJECT		
NOTES: BULKHEAD AT AFT END OF ENGINE ROOM		
ABS COMPLIANT (STEEL VESSELS < 295')		
TRIPPING BRACKETS PLACED AS REQUIRED		
DRAWN BY: DAVID P. HODAPP		DATE: 24 APR 05
SCALE: NTS	REVISION: 2	FILE NAME: midships_const.dwg

Propulsion System Specifications

- Twin Caterpillar 3606 Diesels
  - 2722 BHP @ 1000 rpm
- Ulstein Aquamaster 255 Azimuthing Thrusters
- Transit Speed of 13 Knots
- Bollard Pull Requirements

Baltimore Harbor Tug Transit Speed Estimates

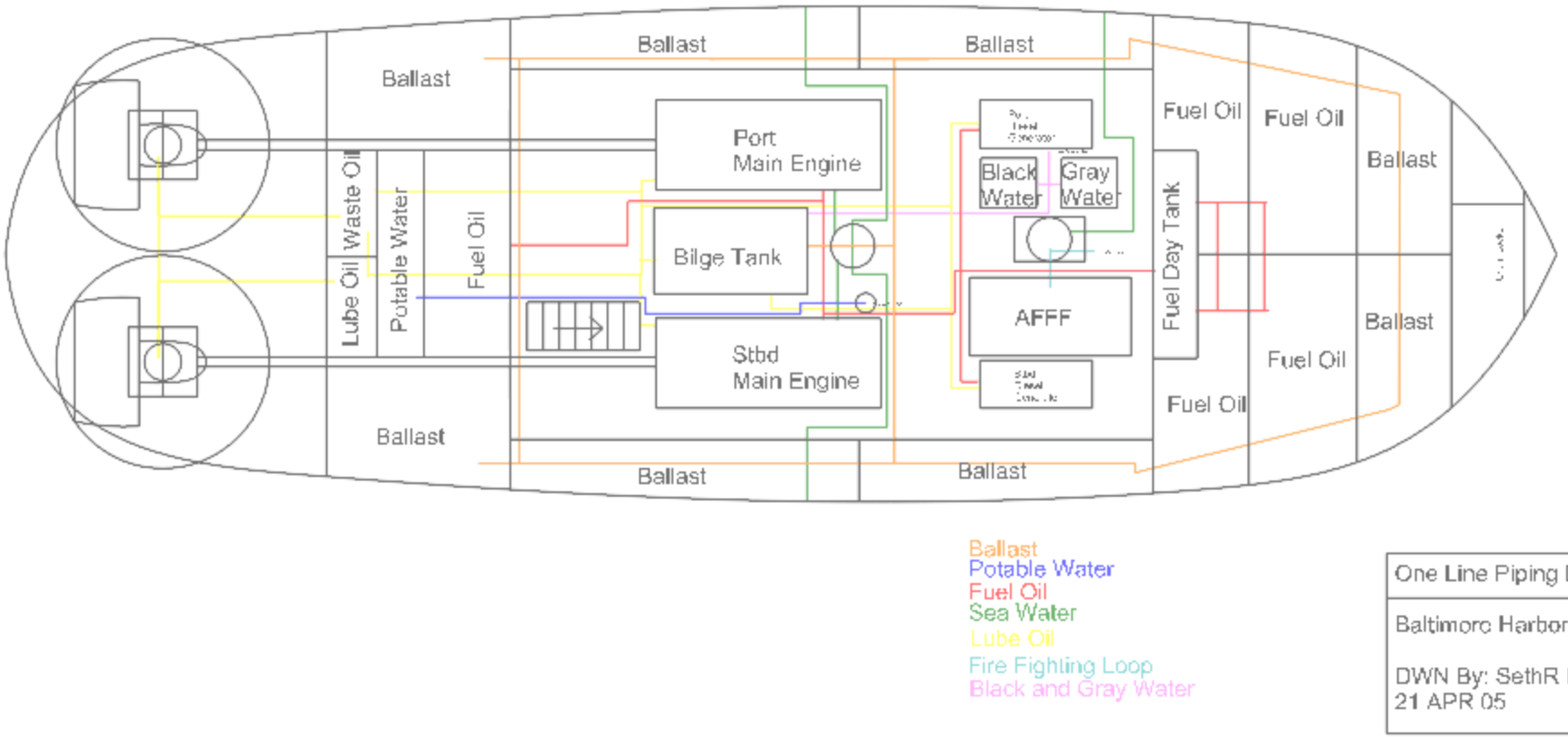
HydroComp NavCad v3.71



Electrical System

- Two Caterpillar 3304B Marine Diesel Generators
- Main Loads
- Paralleled Conditions

Piping Diagram



Weight and Centers Estimates

- Possibilities
  - Light Ship
  - Variable Loads
    - Burn Out With Full Ballast Tanks
    - All Tanks Filled (Fuel and Ballast Simultaneously)
  - Full Load

Weights and Centers Cont’d

- Light Ship
  - Displacement = 341 LT
  - LCG = 46 ft aft FP
  - KG = 10.8 ft
  - LCB = 40 ft aft FP
- Full Load
  - Displacement = 538 LT
  - LCG = 43.0 ft aft FP
  - KG = 10.7 ft
  - LCB = 42.75 ft aft FP
- Variable Loads
  - 10% Full Load With Ballast Compensation (Burn Out)
    - Displacement = 534LT
    - LCG = 44.5 ft aft FP
    - KG = 10.4 ft
    - LCB = 42.75 ft aft FP

ABS - Intact Stability Guidelines for Towing Vessels

ABS Part 5 Appendix 8A

Full Load Δ

5/8A.3	PASS
Lesser of Angle of Unrestricted Downflooding or 40 (deg)	40.00
Point C (deg)	10.59
Heeling Arm Area (ft-deg)	12.77
Righting Arm Area (ft-deg)	62.50

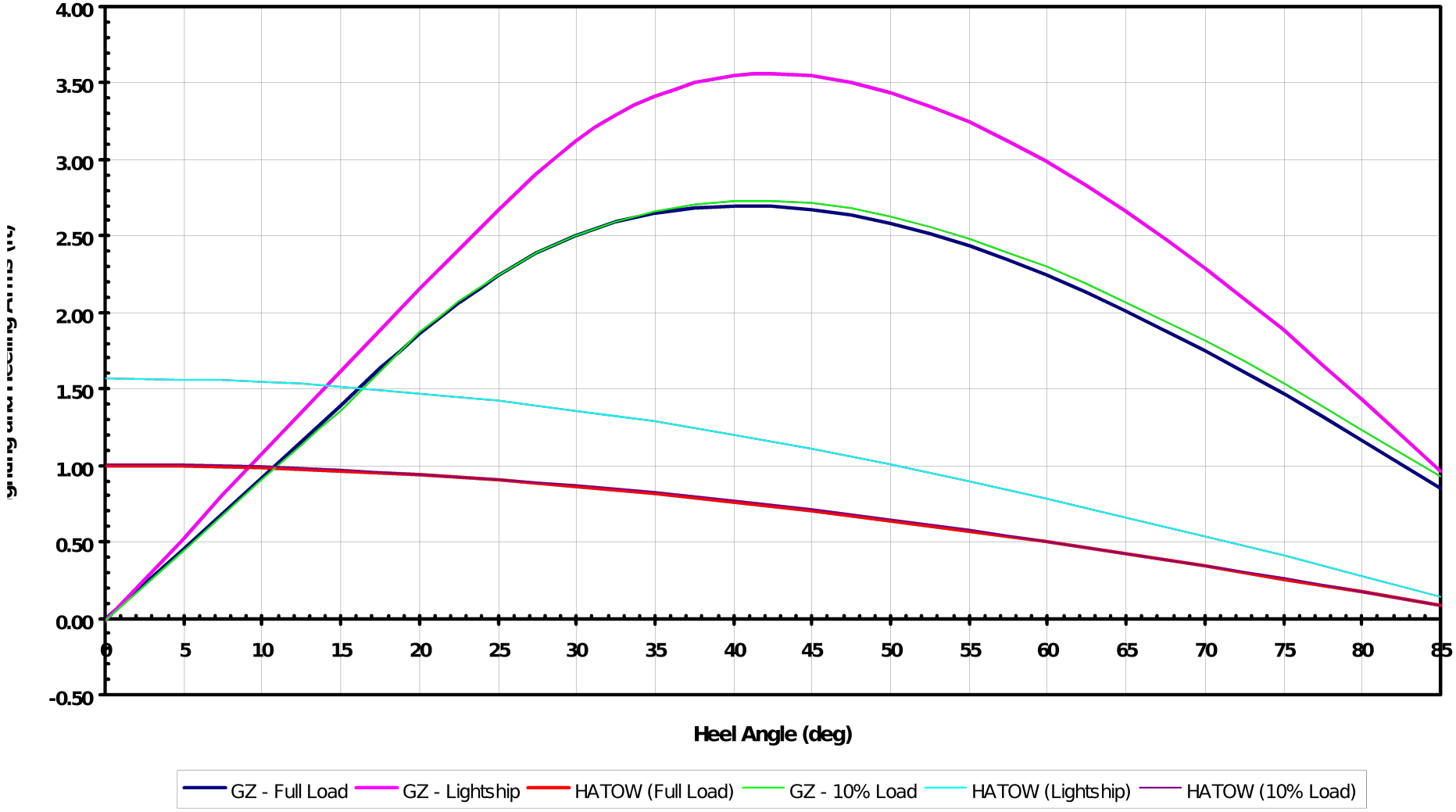
Lightship Δ

5/8A.3	PASS
Lesser of Angle of Unrestricted Downflooding or 40 (deg)	40.00
Point C (deg)	13.97
Heeling Arm Area (ft-deg)	16.86
Righting Arm Area (ft-deg)	70.54

10% Load Δ

5/8A.3	PASS
Lesser of Angle of Unrestricted Downflooding or 40 (deg)	40.00
Point C (deg)	11.37
Heeling Arm Area (ft-deg)	12.40
Righting Arm Area (ft-deg)	62.57

Intact Stability - ABS (Towing)



Intact Stability - Criteria for Towline Pull

CFR (173.090 - 173.095)

Full Load ▲

Section 173.095 Paragraph (b)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (1)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (2)	**PASS**

Lesser of Angle of Unrestricted Downflooding, 40 (deg), or angle of GZ_{max}	40.84
Point C (deg)	5.17
A_0 Area (ft-deg)	69.15
A_1 Area (ft-deg)	41.12

Lightship ▲

Section 173.095 Paragraph (b)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (1)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (2)	**PASS**

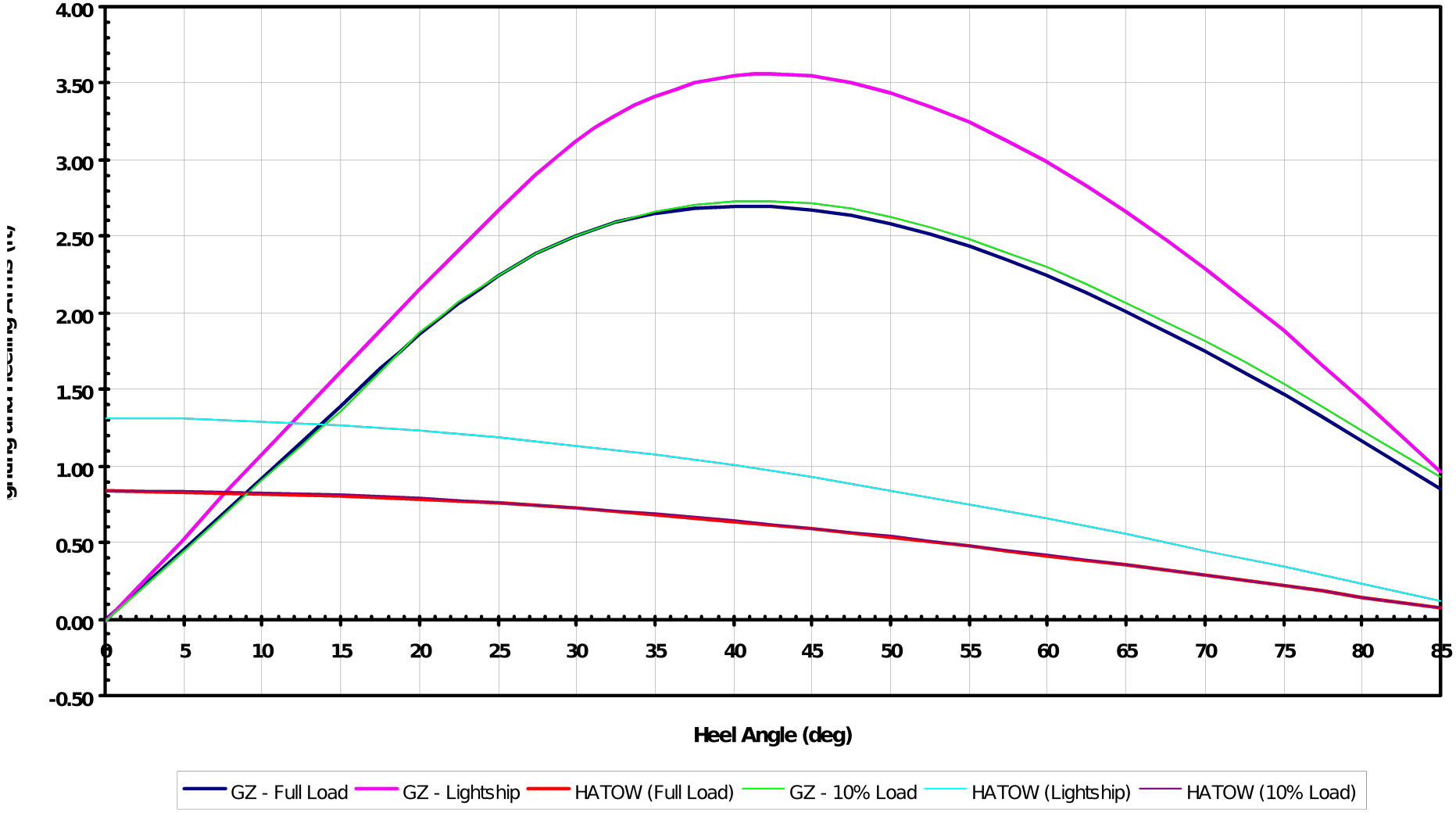
Lesser of Angle of Unrestricted Downflooding or 40 (deg)	40
Point C (deg)	8.00
A_0 Area (ft-deg)	81.63
A_1 Area (ft-deg)	55.01

10% ▲

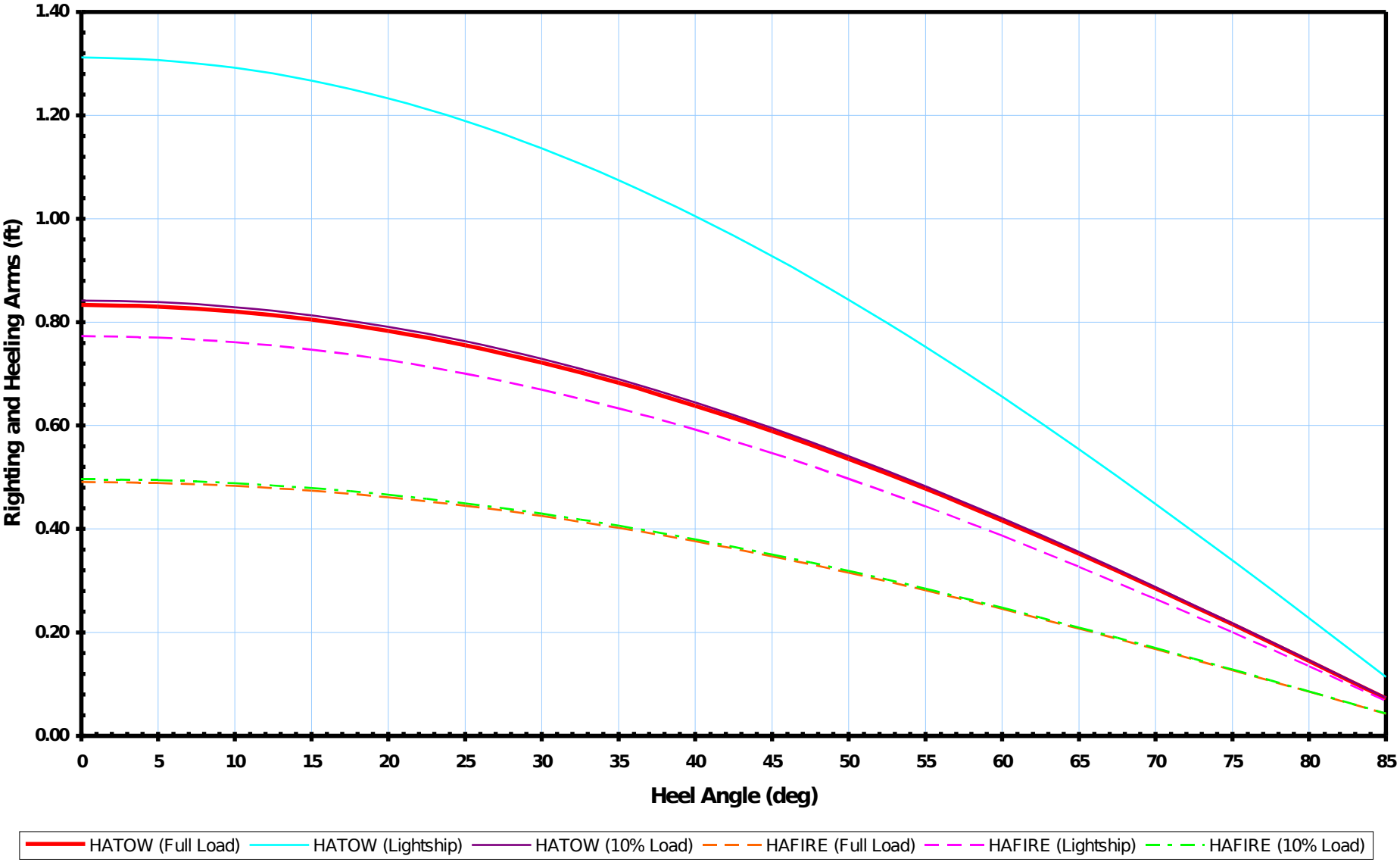
Section 173.095 Paragraph (b)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (1)	**PASS**
Section 173.095 Paragraph (c) Subparagraph (2)	**PASS**

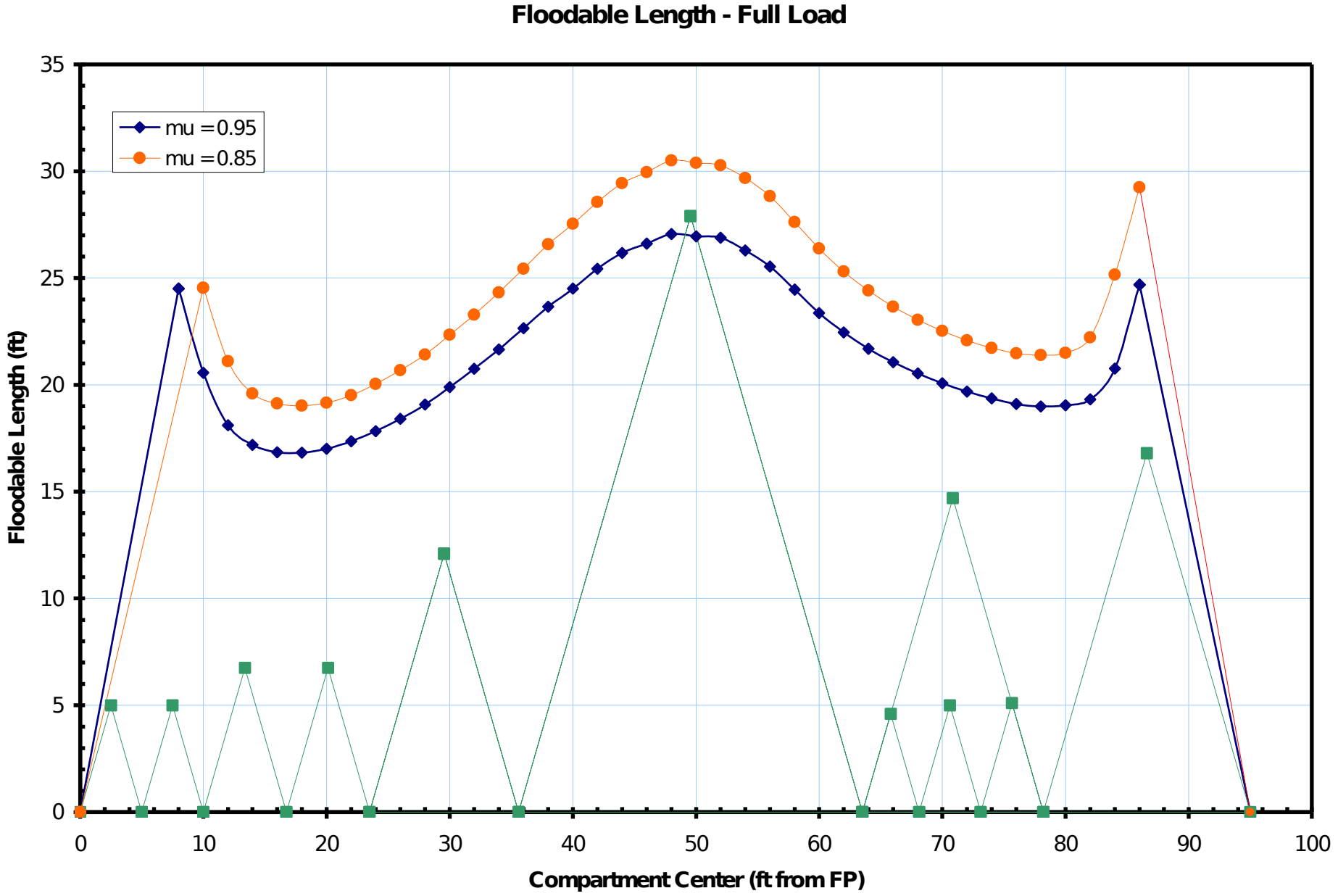
Lesser of Angle of Unrestricted Downflooding, 40 (deg), or angle of GZ_{max}	40
Point C (deg)	6.06
A_0 Area (ft-deg)	66.88
A_1 Area (ft-deg)	39.69

Intact Stability - CFR (Towing)



Intact Stability - Fire Monitor




Floodable Length - Full Load
mu = 0.95
mu = 0.85
Floodable Length (ft)
Compartment Center (ft from FP)
0
5
10
15
20
25
30
35
0
10
20
30
40
50
60
70
80
90
100

Damaged Stability Analysis

Flooded Condition 6 (Compartments)	Tank 9 & Engineroom
Height of Lowest Non-Watertight Opening (ft)	16
Final Waterline (ft)	15
Angle of Heel at Equilibrium (deg)	9.25
Angle of Vanishing Stability (deg)	90

Section 174.207 Paragraph (c) Subparagraph (1) - Final Waterline Criteria		**PASS**
Section 174.207 Paragraph (c) Subparagraph (2) - Angle of Heel Criteria		**PASS**
Section 174.207 Paragraph (c) Subparagraph (3) - Righting Arm Criteria		**PASS**
	Clause (i)	**PASS**
	Clause (ii)	**PASS**

Future Iterations

- Seakeeping Analysis
  - Skeg Included
- Operating Envelope for Fire Monitor
- Operating Envelope for Ballast Compensation
- Cost Analysis

Design Summary

- Designed From Parametric Data
- Designed From Operator Input
- Meets or Exceeds Stability Requirements
  - CFR and ABS
- Meets or Exceeds ABS Structural Requirements
- Fulfills Mission Statement and Circular of Requirements